



Attorney Dkt. No.: 015290-506

Application No.: 09/820,692

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REMARKS

Claims 1-20, as amended, and new Claims 21-22 are pending in the application for the Examiner's review and consideration.

Claims 1-3 and 19 were objected to for the reasons set forth in paragraph 1, on page 2 of the Official Action. Claims 1-3 and 19 have been amended without narrowing the scope thereof to address the Examiner's comments. In particular, Claim 1 has been amended to change "ti" to "to", Claim 2 has been amended to delete "(SAC)", Claim 3 has been amended to change "ia" to "is" and Claim 19 has been amended to change "tyhe" to "the". New Claim 21 recites a method wherein the etch rate selectivity of the dielectric to the stop layer is greater than 30:1. Support for Claim 21 can be found on page 9, lines 15-21 of the specification. New Claim 22 recites a method wherein the etching of the dielectric layer is carried out in a single step. Support for Claim 22 can be found on page 20, lines 17-21 of the specification.

Claims 1-5, 9-12 and 14-20 were rejected under 35 U.S.C. §103(a) as allegedly being unpatentable over U.S. Patent No. 6,174,451 to Hung et al. ("Hung") in view of U.S. Patent No. 6,074,959 to Wang et al. ("Wang"). The reasons for this rejection are set forth in numbered paragraph 3, on pages 2-6 of the Official Action. In particular, the Official Action alleges that Wang discloses the use of an oxygen-containing gas with a fluorocarbon main etchant gas to etch an oxide (dielectric) layer and that it would have been obvious to modify the C₄F₆-based oxide etch of Hung to include the oxygen-containing gases of Wang. This rejection is respectfully traversed for the following reasons.

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Reconsideration of the rejection is requested in view of the following legal precedent regarding rejections based on a combination of prior art references. First, in In re Vaeck, 20 USPQ2d 1438, 1442 (Fed. Cir. 1991), the court stated the following regarding a proper §103 rejection:

"Where claimed subject matter has been rejected as obvious in view of a combination of prior art references, a proper analysis under §103 requires, *inter alia*, consideration of two factors: (1) whether the prior art would have suggested to those of ordinary skill in the art that they should ... carry out the claimed process; and (2) whether the prior art would have also revealed that in so making or carrying out, those of ordinary skill would have a reasonable expectation of success [citation omitted]. Both the suggestion and the reasonable expectation of success must be found in the prior art, not in applicant's disclosure." (Vaeck at 1442.)

In addition to the above, In re Imperato, 179 USPQ 730 (CCPA 1973) set forth the following regarding a proper combination of references:

"With regard to the principal rejection, we agree that *combining* of Schaefer with that of Johnson or Amberg *would give the beneficial result observed by appellant*. However, the mere fact that those disclosures *can* be combined *does not make the combination obvious unless* the art also contains *something to suggest the desirability* of the combination." (Emphasis added) (Imperato at 732).

Claim 1 is directed to a method of etching a dielectric layer with selectivity to an underlying stop layer, comprising (a) supporting a semiconductor substrate in a plasma etch reactor, the substrate including a dielectric layer over a stop layer; (b) supplying an etchant gas to the plasma etch chamber; and (c) etching openings in the dielectric layer by energizing the etchant gas into a plasma state, the etchant gas comprising a *hydrogen-free* fluorocarbon gas represented by C_xF_y gas wherein $y/x \leq 1.5$, an *oxygen-containing* gas and

optional carrier gas. As set forth below, the combination of references fails to teach or reasonably suggest all of the claim limitations. Further, persons of ordinary skill in the art would not have had the requisite reasonable expectation of success when combining the references in the manner suggested in the Official Action.

Hung discloses an oxide etching process for selectively etching oxide over a feature having a non-oxide composition in a high-density plasma reactor using unsaturated fluorocarbons with a low but *finite hydrogen content* (see abstract, Column 5, lines 47-56 and Column 11, lines 1-10). In contrast to the claimed method, Hung does not disclose or suggest a method of etching a dielectric layer with selectivity to an underlying stop layer wherein the etchant gas comprises an *oxygen-containing* gas. Furthermore, Hung does not disclose or suggest a method of etching a dielectric layer using an oxygen-containing gas to obtain selectivity to an underlying silicon nitride stop layer, as recited in Claim 3. Instead, Hung adds "a more heavily polymerizing fluorocarbon gas" (column 8, lines 13-16).

* Hung's overetch to obtain "a complete etch without producing excessive nitride faceting" uses an etchant gas which is an oxygen-free gas. Hung states that CH_2F_2 , Ar and oxygen are used to etch nitride portion 26 (see column 10, lines 43-51). Hung specifically states that the "*oxygen destroys any nitride selectivity*" (Emphasis added, see column 10, line 51). Thus, Hung *teaches away* from using an oxygen-containing gas in etching a dielectric layer with selectivity to an underlying nitride layer.

The Official Action cited Wang for disclosing the use of oxygen gas with the main-etchant gas. In particular, the Official Action cites a portion of Wang stating that "[t]he above processes can be modified by the addition of carbon monoxide, nitrogen, or oxygen,

all of which are known to enhance selectivity and increase the etch stop margin" (column 10, lines 23-26). Wang does not teach addition of an oxygen-containing gas to improve selectivity and there are no examples in Wang wherein the etchant gas includes an oxygen-containing gas. Even though Wang mentions carbon monoxide and oxygen in column 10 thereof, one of ordinary skill in the art would not have been led to add such gases to the etchant gas of Hung in view of Hung's teaching that "oxygen destroys any nitride selectivity" (column 10, line 51 of Hung).

As discussed above, the Official Action has not set forth a tenable basis establishing the requisite motivation to combine Wang with Hung in a manner that would produce the claimed method. Furthermore, the Official Action does not set forth an explanation as to why one of ordinary skill in the art would have had a reasonable expectation of success in combining Hung and Wang as suggested in the Official Action. Given Hung's teaching away from using an oxygen-containing gas, it is submitted that a person of ordinary skill in the art would not have been led to use an oxygen-containing gas to etch openings in the dielectric layer of Hung.

Applicants respectfully submit at least for the reasons discussed above that Claim 1 and all the claims dependent therefrom are clearly patentable over the combination of Hung and Wang.

Claims 6-8 and 13 were rejected under 35 U.S.C. §103(a) as allegedly being unpatentable over Hung and Wang in further view of U.S. Patent No. 6,228,438 to Schmitt ("Schmitt"). The reasons for the rejection are set forth in numbered paragraph 4, on pages 6-7 of the Official Action. The Official Action alleges that Schmitt discloses a dual

frequency capacitively coupled plasma reactor including an upper showerhead electrode and a bottom electrode (see column 8, lines 1-10) and that it would have been obvious to modify the etch process of Hung and Wang to include other commercially available plasma etch reactors. This rejection is respectfully traversed.

Claims 6-8 and 13 depend from Claim 1 and thus are patentable over the cited references for at least the reasons that Claim 1 is patentable over Hung and Wang.

It is submitted that the differences between the claimed subject matter and the prior art are such that the claimed subject matter, as a whole, would not have been obvious at the time the invention was made to a person having ordinary skill in the art.

In view of the foregoing, it is submitted that the present application is in condition for allowance and such action is earnestly solicited.

Respectfully submitted,

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Appendix A - Attachment to Amendment dated June 28, 2002

Marked Copy: Claims 1-3 and 19 [As-Amended]

1. (Amended) A method of etching a dielectric layer with selectivity to an underlying stop layer, comprising:

supporting a semiconductor substrate in a plasma etch reactor, the substrate including a dielectric layer over a stop layer;

supplying an etchant gas [ti] to the plasma etch chamber; and

etching openings in the dielectric layer by energizing the etchant gas into a plasma state, the etchant gas comprising a hydrogen-free fluorocarbon gas represented by C_xF_y gas wherein $y/x \leq 1.5$, an oxygen-containing gas and optional carrier gas.

2. (Amended) The method of Claim 1, wherein the openings comprise vias, contacts, and/or trenches of a dual damascene structure, a self-aligned contact [(SAC)] structure or self-aligned trench structure.

3. (Amended) The method of Claim 1, wherein the stop layer is silicon nitride and the etch rate selectivity of the dielectric to the silicon nitride [ia] is at least 10.

19. (Amended) The method of Claim 1, wherein the etched openings open onto flat and corner portions of the stop layer, the dielectric layer comprises BPSG and the stop layer comprises silicon nitride, the etch rate selectivity of the BPSG to the flat and corner portions of [tyhe] the silicon nitride being at least 15.